

GenFit2 for sPHENIX tracking progress: Test with sPHENIX TGeo and Field Map

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Recent progress on GenFit2 tracking:

Advantages of GenFit2:

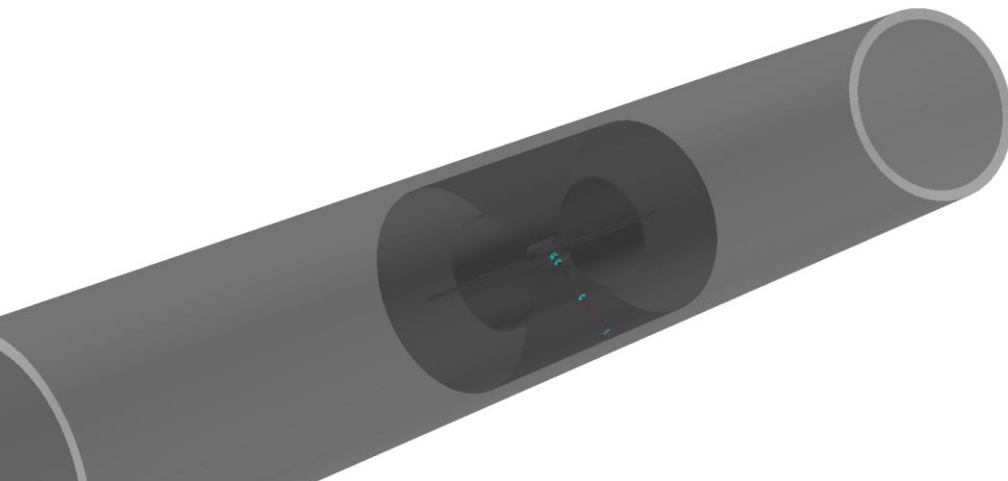
1. Support complex tracker (ladder geometry)
2. Integration with RAVE (the vertexing tool)
3. Wide support (Tested in many experiments)

Tested GenFit2 with RKTrackRep:

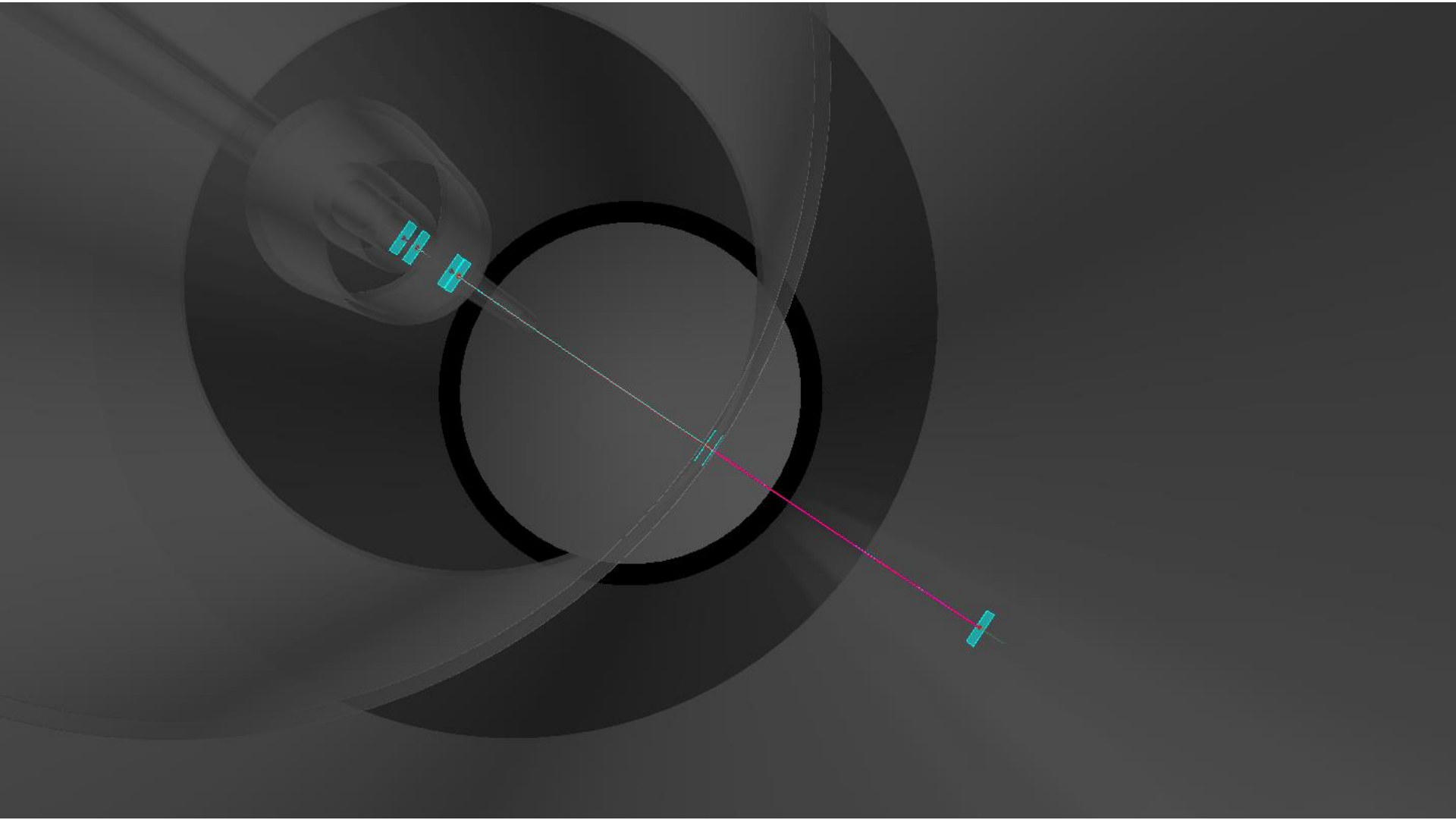
- RKTrackRep:
 - Material effect
 - Field effect
- Fitter Test:
 - z plane Test
 - 3 layer cylinder test
- **Test GenFit with sPHENIX TGeo and field map**
 - The fitting result is a little bit better than current Kalman
 - Less biased
 - A little bit better p1 term for resolution
 - GenFit is fast: in this test bench, finished 1M tracks in 850s => 0.85ms/trk.

Progress in last week's MAPS workshop:

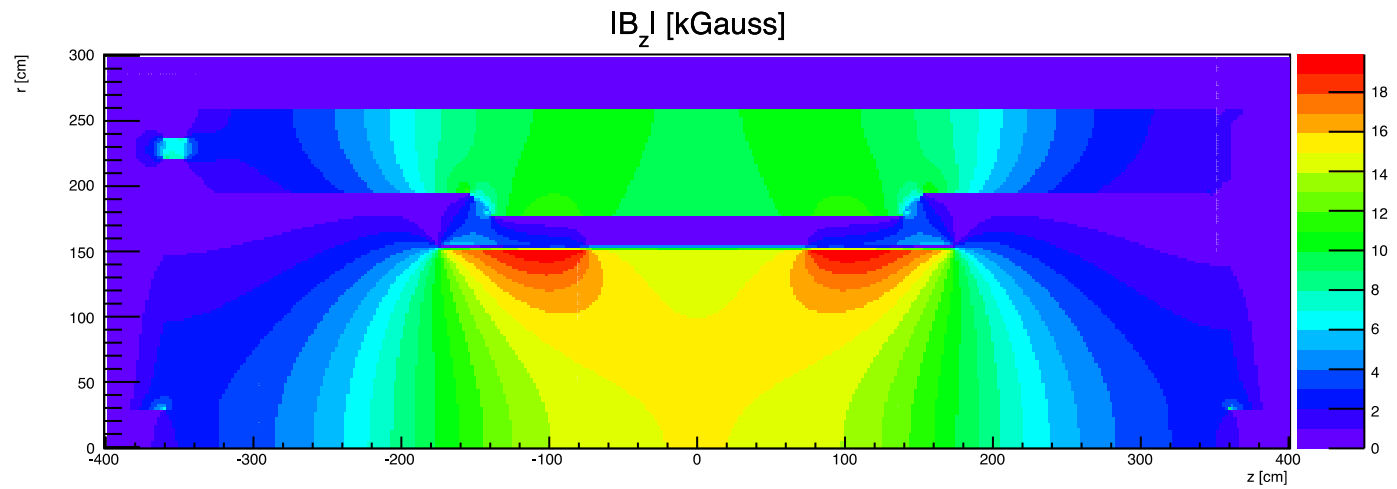
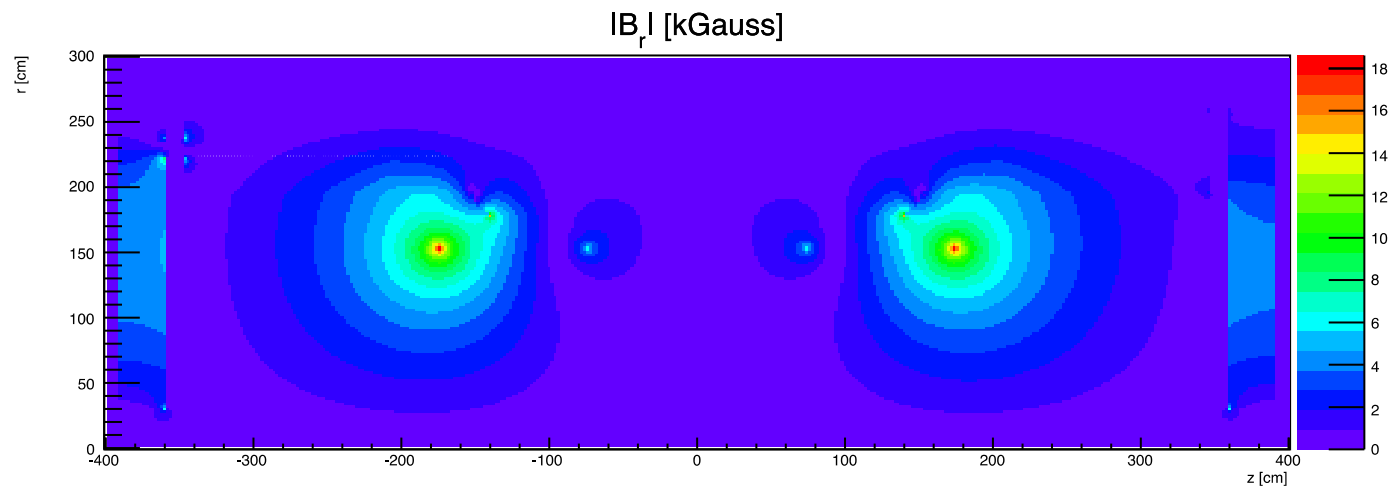
- Darren and Jin implemented GDML to TGeo for the Beam Pipe and the 7 Si Cylinders in default G4_Svtx.C. Many thanks to Abhisek, Chris, etc. Future on the fly G4=>TGeo translation needs more work.
- Darren and Jin implemented a analysis module based on “SvtxTrackEval” which generates measurements (cluster coords and cluster size) from simulation.
 - Also includes MC truth information.
 - Also includes the fitting results from sPHENIX current Kalman Filter, by Alan Dion, “CylindricalHough”.
- I made a interface to read in sPHENIX 2D field map.
- Interfaces to GenFit that handles these measurements.



Detector and Measurements:



Field map (2D) read in:



Testing procedure

Generate 1M tracks with pT from 1 to 40 GeV.

Vertices are along beam line (-5,5) cm.

G4 Simulation and Reconstruction (Alan's Kalman) done by AnaSvtxTracksForGenFit.

Fit the data using GenFit2:

- Using sPHENIX TGeo and 2D field map.
- Smeared MC truth as the seed.
- Fit!
- Extrapolate fitted track to beam line to get the initial pos, mom, cov, etc.

Major quantities checked:

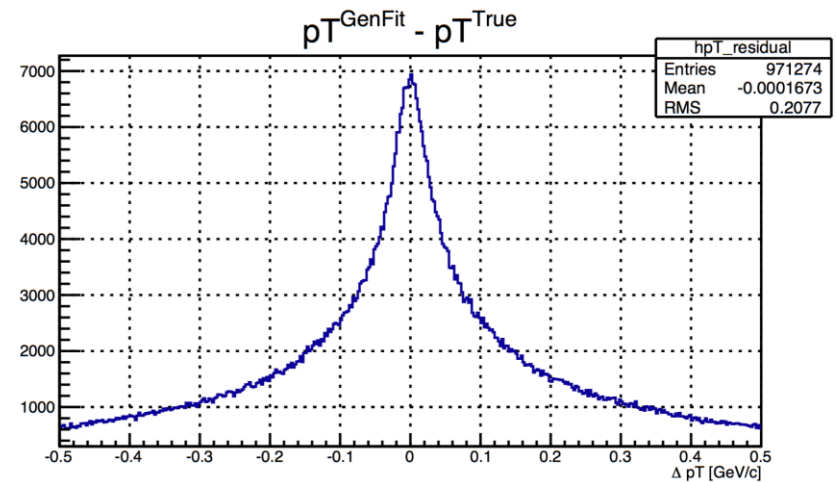
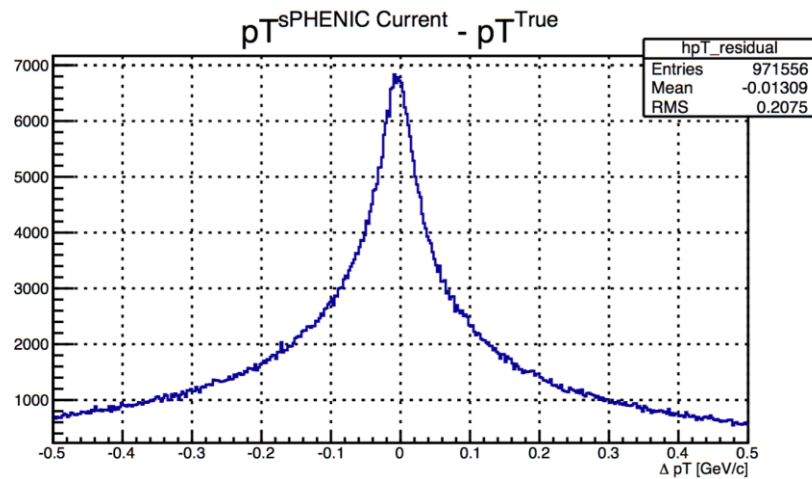
- pT resolution.
- DCAr resolution.

References:

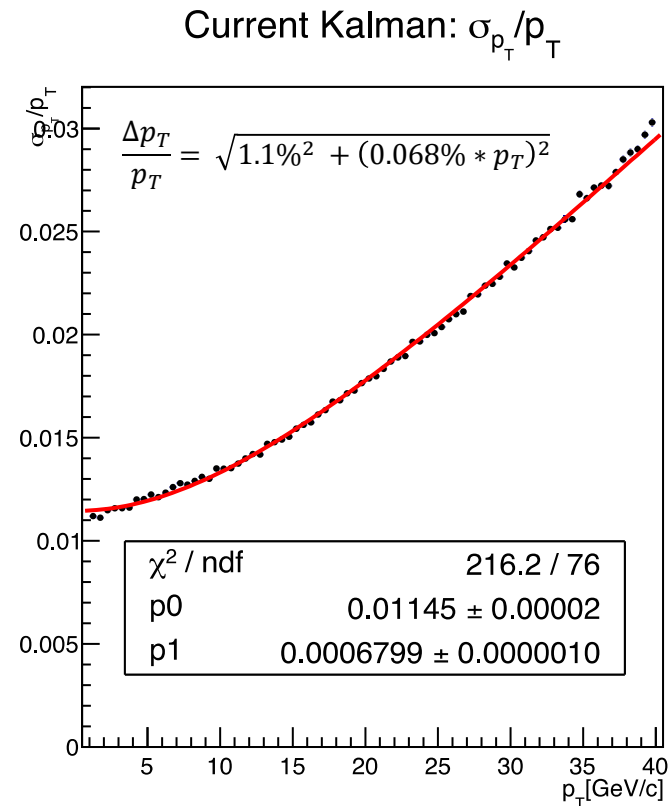
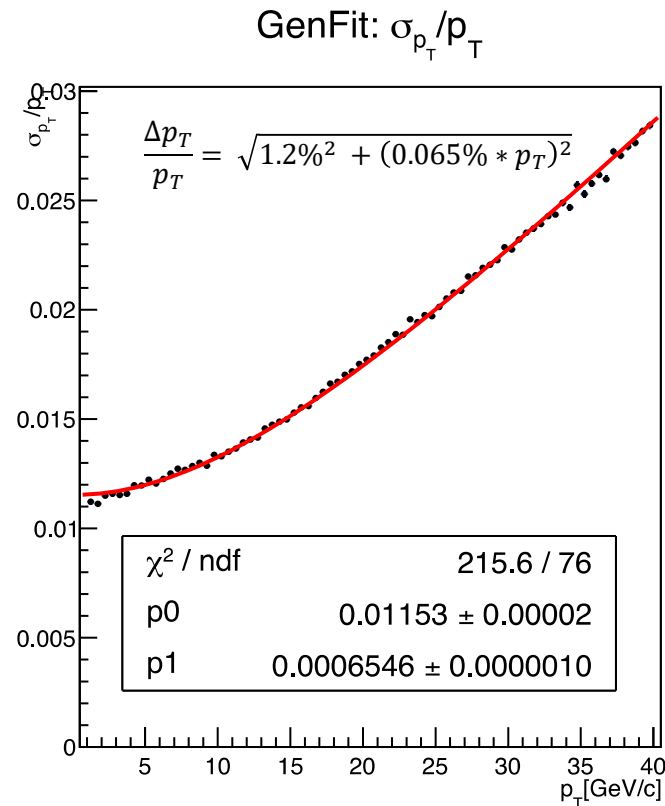
- Current sPHENIX Kalman
- sPHENIX pre-Conceptual Design Report, Oct, 2015

pT residual comparison:

I believe this is due to field effect:



pT resolution: GenFit vs Current Kalman



p0 term is 0.8% (relative) larger than Current Kalman
p1 term is 3.7% (relative) smaller than Current Kalman,

pT resolution: cont'd

sPHENIX pre-Conceptual Design Report, Oct, 2015

<https://indico.bnl.gov/getFile.py/access?resId=0&materialId=11&confId=1483>

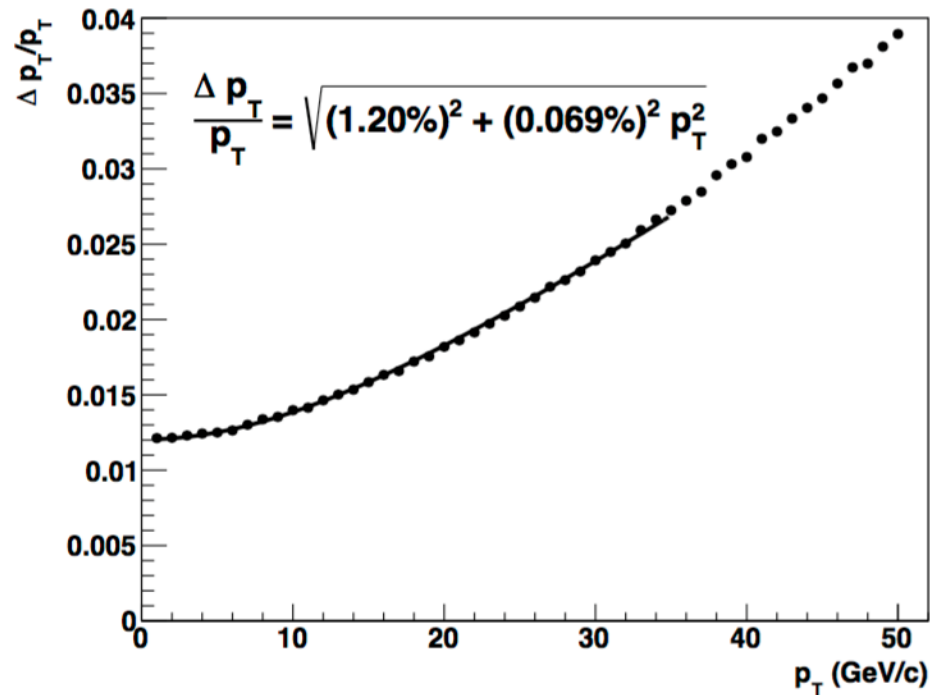
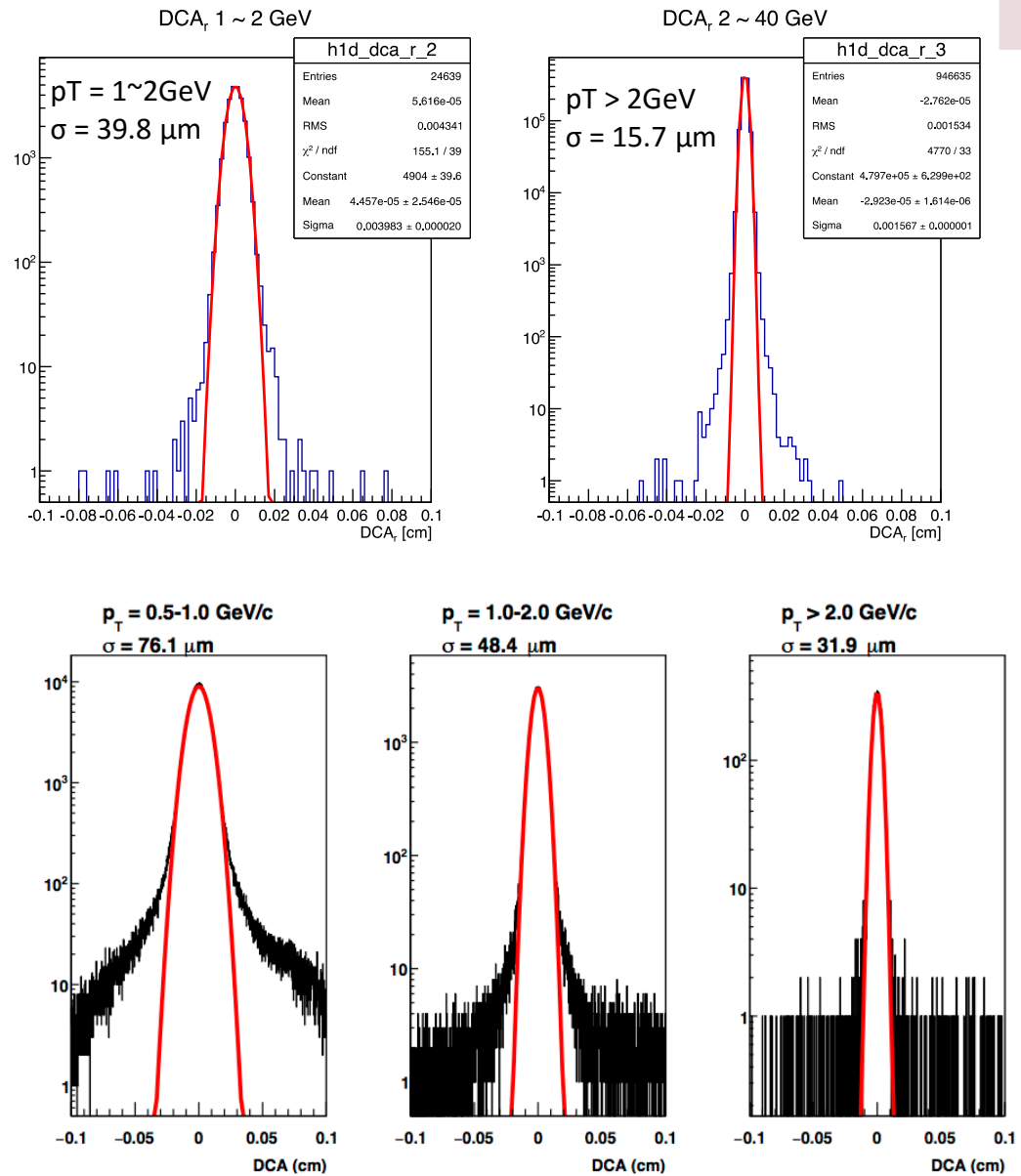


Figure 4.11: Momentum resolution of the silicon tracker for single pions.

- Track DCAr resolution without vertex smearing using GenFit.
- This result is a last minute result. So very preliminary.



- DCAr resolution with vertex smearing in sPHENIX PCDR. So not ready for comparison yet.
- Mike is working on DCAr resolution without vertex smearing for comparison.

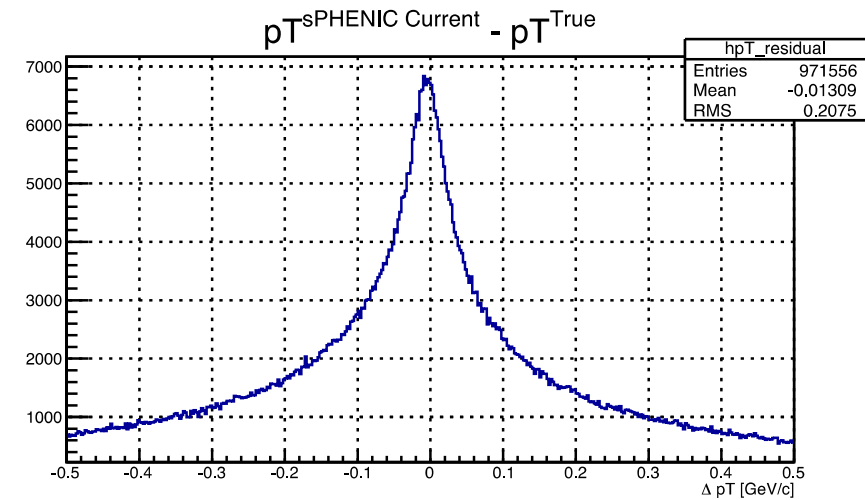
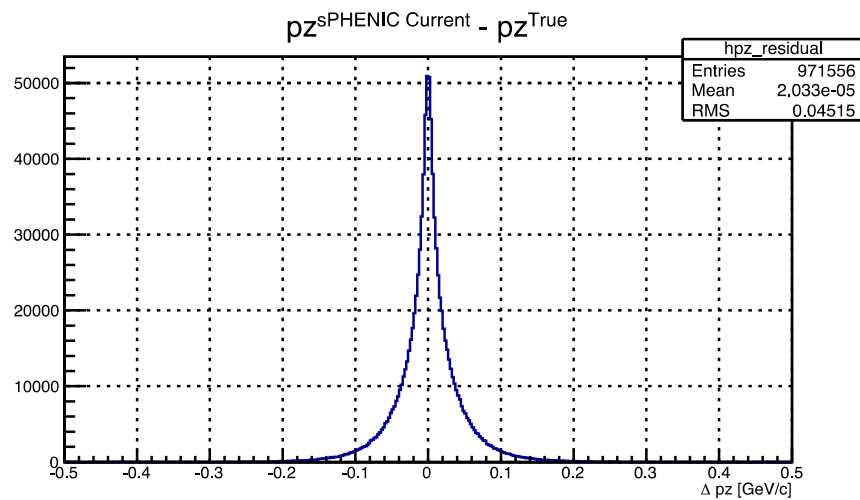
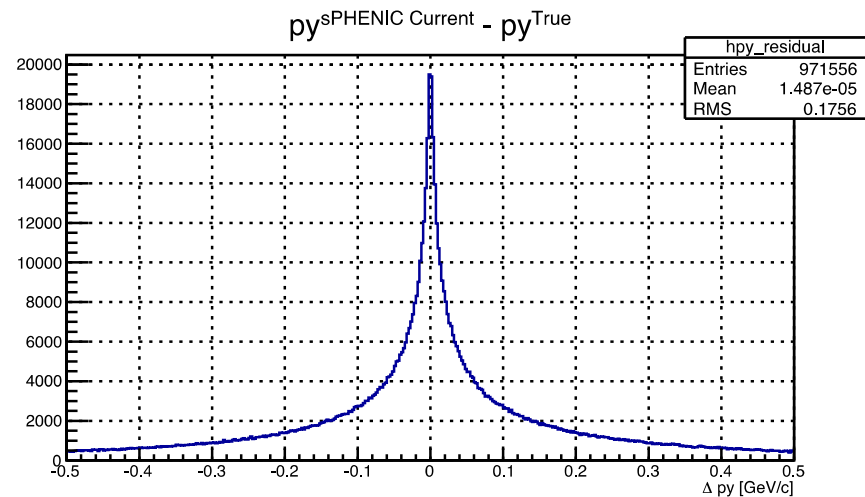
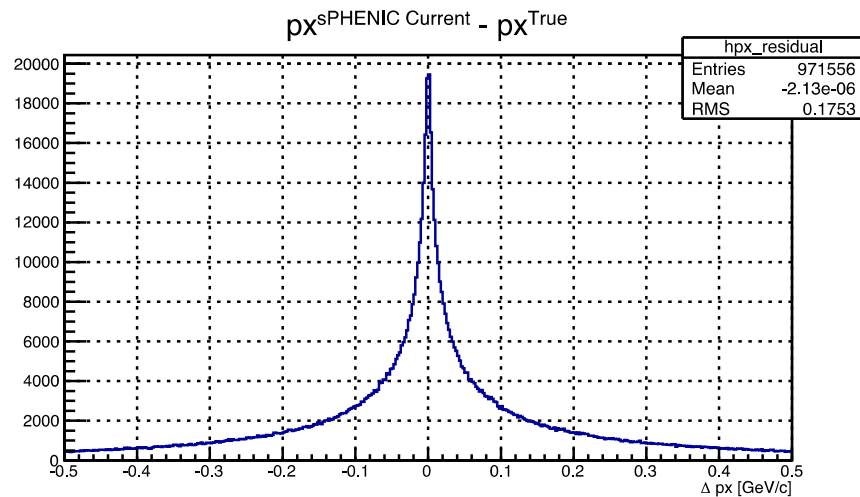
Figure 4.5: The DCA resolution of the silicon tracker in three track momentum ranges, from tracks reconstructed in central HIJING events.

Next Step: Integrate GenFit into sPHENIX software

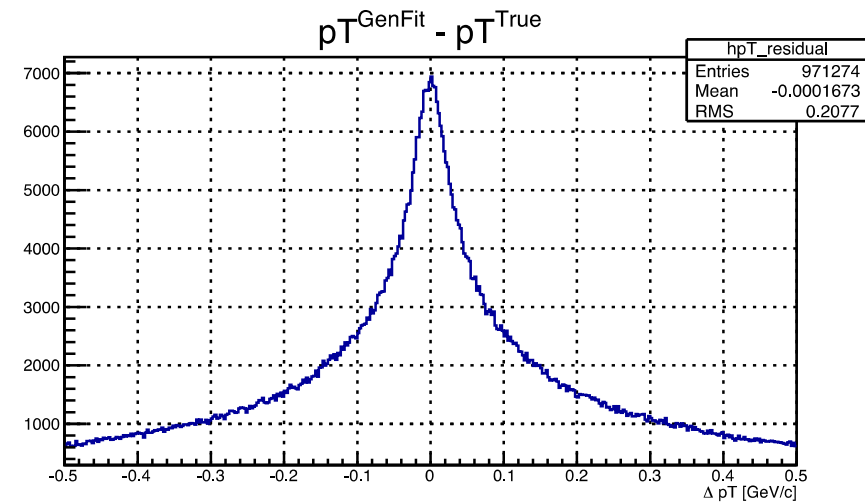
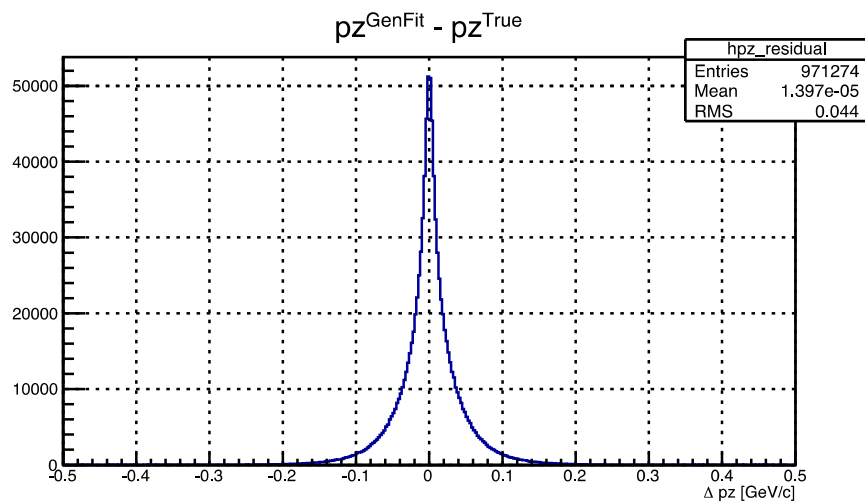
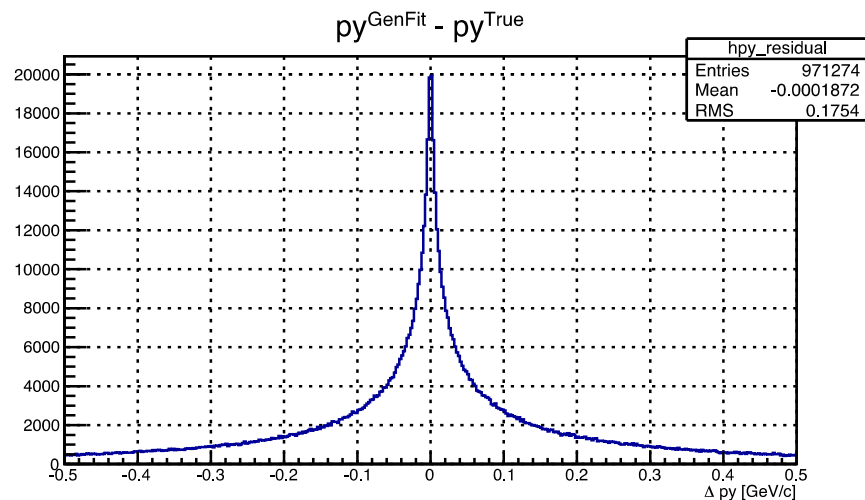
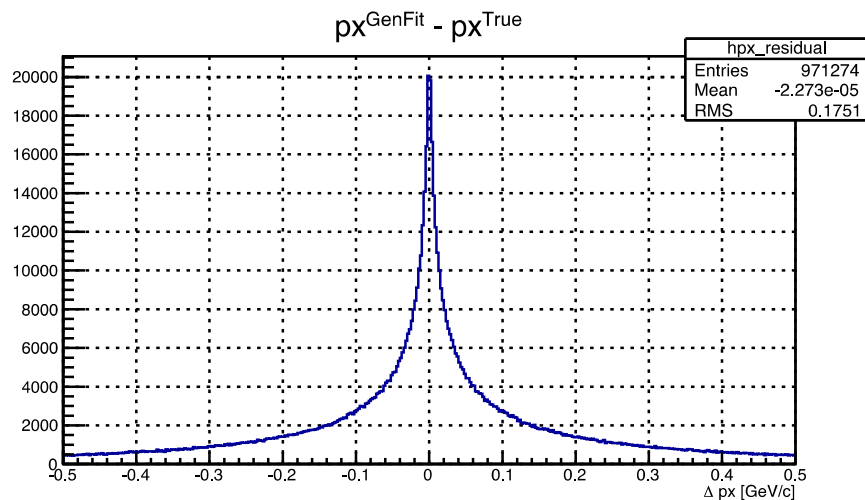
- Work with Chris to compile a GenFit library in RCF.
 - Most recent GenFit in GitHub.
 - <https://github.com/GenFit/GenFit>
 - I have done it in RCF in my personal locations.
 - Jin suggested that we use the original GenFit source. Make move all the changes to external sPHENIX library.
- Make a set sPHENIX interfaces to GenFit.
 - Mike, Jin and I just started working on it
 - Input seed and a set of measurements from patten recognition
 - Tool box that propagate tracks to planes, lines, cylinders, etc.
 - Already built in GenFit just needs some simple interface to sPHENIX
 - Output pos, mom, cov, etc at target.
 - etc.

Backups

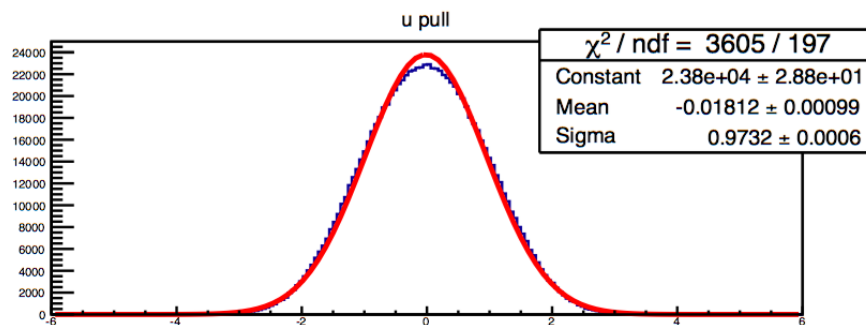
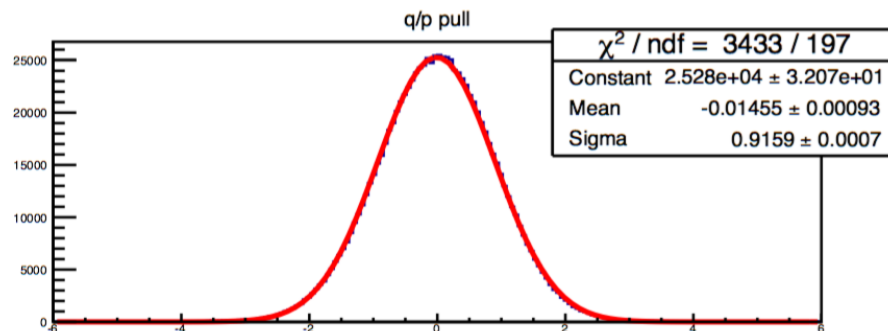
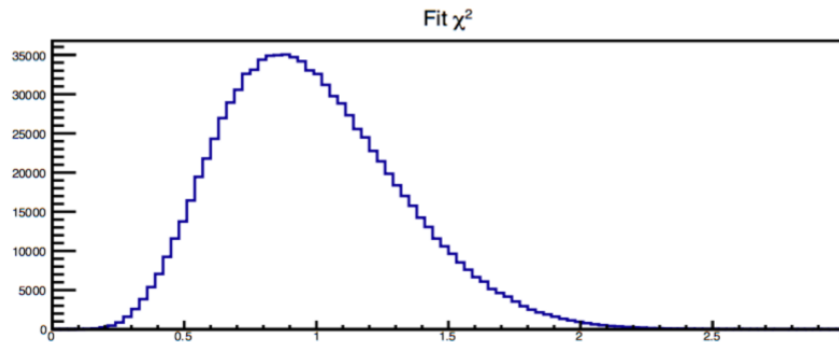
Current vs. True



GenFit vs. True



GenFit chi2/ndf and pull distribution



DCAr using current Kalman

